International Journal of Educational Development 94 (2022) 102657

Contents lists available at ScienceDirect

International Journal of Educational Development

journal homepage: www.elsevier.com/locate/ijedudev

Indiscipline: The school climate of Brazilian schools and the impact on student performance☆

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ARTICLE INFO

JEL classification:
C21
I24
I25

Keywords:
School climate
School performance
PISA

ABSTRACT

The article aims to assess the impact of the school climate on the academic performance of Brazilian students through the 2018 Program for International Student Assessment (PISA). The methodology used was the propensity score matching (PSM), Nearest neighborhood, Kernel, Radius, Inverse Probability-Weighted Regression-Adjustment (IPWRA), and the dose-response function (DRF). The results showed that a negative school climate is detrimental to students' school performance and the intensity of the climate affects grades in different ways. The peer effects on students' grades are significant, indicating that classmates matter for the perception of climate in addition to impacting the grade of others. Furthermore, the disciplinary climate in reading classes is one of the strongest predictors of academic performance and it is extremely important to understand the relationship between them.

1. Introduction

According to the OECD (2019), disciplinary climates vary across countries and economies in language-of-instruction classes. The countries with the most positive disciplinary climate are Albania, Beijing, Shanghai, China, Belarus, Japan, Kazakhstan, Korea, and Viet Nam while the countries with the least positive climate are Argentina, Brazil, France, Greece, and Spain (OECD, 2019). For example, in Japan, only 3% of the students reported that there is noise and disorder in every lesson. Meanwhile, in Argentina, Brazil, France, Greece, Israel, Morocco, and Turkey at least 25% of the students reported that they, and their peers, cannot work well in every or most language classes (OECD, 2019).

In light of the foregoing the daily life of Brazilian schools, teachers face conflicts and disagreements among students. These conflicts, such as bullying, indiscipline, violence, and incivility, have been growing over the years (Leme, 2006; Biondi, 2008). According to the OECD (2019), the Brazilian school climate is the worst among all the countries evaluated, ahead only of Argentina.

School climate is defined as the group of subjective effects identified by individuals when they interrelate with the formal structure, as well as the style of school administrators, interfering in attitudes, beliefs, values, and motivation of teachers, students, and staff (Haynes et al., 1997; Silva, 2001; Cohen et al. 2009; Berkowitz et al., 2017). The school climate can also be recognized as the atmosphere of a school, that is, the quality of relationships and knowledge that are developed there, in addition to the values, attitudes, feelings, and the sensations perceived by different members of the school community (Gaziel, 1987; Taylor, 2008; Glenn, 2009; Brito et al., 2010; Thapa et al. 2013; Vinha et al., 2016). Therefore, the climate is a critical factor for the health and effectiveness of a school, being able to influence the behavior of the subjects who live there, affecting interpersonal relationships.

Thiébaud (2005) points out that students are sensitive to the school climate, and this environment not only influences their behavior and adaptation but also their learning. Thus, conflicts such as bullying lead to a change in this environment that affects student involvement (Forster et al., 2019), contributing to transforming the school into an uncomfortable and confrontational place (Pigozi and Machado, 2015). Furthermore, peer rejection in childhood and adolescence increases the risk of misconduct and decreases participation and interest in school, increasing the probability of dropping out (French and Conrad, 2001).

☆ This work was carried out with the support of the Coordination for the Improvement of Higher Education Personnel – Brazil (Capes) – Financing Code 001. Errors and omissions are the authors' responsibility

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https://doi.org/10.1016/j.ijedudev.2022.102657
Received 25 October 2021; Received in revised form 26 June 2022; Accepted 3 August 2022
Available online 19 August 2022

Visitors to a school, including parents and education inspectors, can identify a positive school environment within a few minutes (Dewitt, 2016). The structure of the school, the tone used in the hallways, the enthusiasm of the staff, and the way students interact at break time are some of the signals that visitors use to quickly and comprehensively assess the atmosphere of a school (OECD, 2019). Rutter (1979) pointed out that the quality of the school climate has an immediate impact on the students' sense of security, well-being, and behavior. A positive school climate can promote good academic performance, the well-being and self-esteem of students (Hoge et al., 1990; Way et al., 2007; Macneil and Prater Busch, 2009), and may persist for years (Hoy et al., 1998).

The work is organized into five sections, in addition to this introduction. In the next section, a literature review is carried out on the definition of the school climate and its relationship with academic performance. Subsequently, the database, descriptive statistics, and empirical strategy are discussed. Finally, the results are discussed, and the conclusions are drawn.

The purpose of this article is to assess the impact of the school climate on the academic performance of Brazilian students through the questionnaire of the Program for International Student Assessment (PISA) released in 2018 by the Organization for Economic Co-operation and Development (OECD). The school climate was defined using an index created by PISA based on five questions[3] that students answered according to how often situations occurred in class. The estimation strategy will be to compare those students who reported having a negative school climate (treatment group) with those with a good school climate (control group) according to the observable characteristics. The propensity score matching (PSM) allows us to create, through observable characteristics, a control group that is similar to the treated one, with the difference between the groups being the school climate. Thus, we verified, on average, the effect of this variable on student performance. So, the effects of school climate are isolated. The dose-response function (DRF) allows us to measure the intensity of the school climate's effect on student performance.

This article aims to contribute to filling the gap in studies on the Brazilian school climate and the impact on student performance. Most of the studies measure the impact of climate on performance (Taylor, 2008; Thapa et al., 2013; OECD, 2013, 2017) or points out the importance of a positive school climate for students (Rutter, 1983; Berkowitz et al., 2017; OECD, 2019). The only study for Brazil that explores the relationship between school climate (perceived by teachers) and student outcomes focuses on how these measures are impacted by principal leadership (Oliveira and Waldhelm, 2016). However, as far as we know there are no studies that address the association between school climate, perceived by students, and student performance in Brazil using this methodological approach. Specifically, we apply a dose-response function that, to the best of our knowledge, has never been applied to the matter of school performance measures. This methodology is important when the subject is school climate since students can be exposed to different degrees of school climate.

2. Literature review

Students' learning levels and academic performance can be affected by the school climate. According to Pallas (1988), the academic environment is associated with educational results, especially performance. According to Perkins (2006, 2007, 2008) factors such as interpersonal relationships, physical structure, and context can positively or negatively influence school performance, with freedom for dialog, trust in teachers, and working in partnership with the school management promoting a good atmosphere. An environment free from other concerns, from the physical infrastructure to feeling good in that environment, would favor a better availability for the students to dedicate themselves to studies (Perkins, 2006, 2007, 2008; Thapa et al., 2013). Furthermore, having friends has been shown to ease loneliness, increase self-esteem, promote satisfaction, and school engagement, avoid some victimization, and, through adequate support, dampen the consequences of bullying on mental health (Adams et al., 2011; Mclaughlin et al., 2009). Positive school climates support students' social and emotional development helping them to be effective learners (Hamre and Pianta, 2010).

Student academic performance is associated with educational climate experiences, including a greater commitment to academic performance by peers or teachers (Eccles and Midgley, 1989; Phillips, 1997). Several studies point to the relationship between a positive school climate and higher academic performance (Bryk and Schneider, 2002; Hamre and Pianta, 2005; Uline and Tschannen-Moran, 2008; Casassus, 2008; Berkowitz et al., 2015; Hamlin, 2021; Wang et al., 2022). According to Casassus (2008), in schools where students enjoy a positive emotional climate, performance was higher by 36% in the average grade in the Language test and 46% in the Mathematics test. Berkowitz et al. (2015) found that the school climate increased the student test scores for fifth and eighth grades in Israel. Wang et al. (2022) used the PISA dataset to analyze disciplinary climate and mathematics achievement finding a positive association between the disciplinary climate and the achievement at the school level. Uline and Tschannen-Moran (2008) analyzed the school climate perceived by teachers in the USA and found that school climate plays a mediating role in the relationship between school facility quality and student performance. The authors found that when learning is carried out in inadequate facilities tends to be less focused on academics and the climate is perceived as less orderly and serious. Hamlin (2021) pointed out that attendance is only one potential benefit of a positive school climate for American students.

Blank and Shavit (2016) analyzed elementary and middle schools in Israel using the National Authority for Measurement and Evaluation, to obtain the test scores through multilevel regression and found that transgressive behaviors in the classroom are negatively correlated with students' academic performance. It is important to emphasize that Blank and Shavit (2016) sought to understand the correlation between classroom disciplinary climate and students' performance. Meanwhile, in the present study through the methodologies used, PSM and DRF, it is possible to evaluate the causal effect between school climate and student performance based on the degree of exposure to school climate.

Reynolds et al. (2017) addressed the correlation between school climate and student performance for Australians. The authors used data from the National Assessment Program – Literacy and Numeracy (NAPLAN) and the methodological approach was structural equation modeling. Through this methodology, the authors found no direct association between school climate and students' performance, but school climate significantly predicted numeracy achievement through school identification. The present study also differs from Reynolds et al. (2017) in terms of methodology since it intends to assess causality and not the correlation of the two dimensions mentioned above.

On the other hand, student absenteeism is strongly related to the school climate (Reid, 1983; Gottfried, 2009; Vaillancourt et al., 2013; Daily, 2020). Reid (1983) used a social anthropological approach and questionnaires with selected instruments to address the perceptions of school absentees on their initial and continued reasons for missing school. The author found that 56% of students from South Wales, a region of Great Britain, cited institutional causes for skipping school initially and 86% gave the same reasons for continuing to skip classes. These institutional reasons were linked to the students' perception of the school climate, such as school rules and punishments, bullying, and

[3] The index is created based on the frequency ('all classes', 'most classes', 'some classes', 'never or almost never') with which the following situations occurred in classes in the language of instruction: 'Students don't listen to what the teacher says.'; 'There is noise and disorder.'; 'The teacher has to wait a long time for students to quiet down.'; 'Students cannot work well.'; 'Students don't start working for a long time after the lesson begins.'.

teachers. Wu et al. (1982) pointed out that the suspension of a student is a matter of his/her misbehavior, but it is more a question of how the school treats its students. Gottfried (2009) investigated the excused versus unexcused absences regarding students' standardized test performance in reading and math. The study was carried out for Philadelphia School District using fixed-effects models with clustering at the classroom level. Gottfried (2009) found that students with a higher proportion of unexcused absences place them at academic risk, particularly in math achievement. Vaillancourt et al. (2013) used data from the Southern Ontario Public School Board to measure the link between absenteeism and GPA using a cascade model. The authors found that Grades 5, 6, and 8 GPAs were negatively associated with absenteeism. Daily et al. (2020) analyzed students from West Virginia through binary and ordinal probit regression model and found that a positive school climate and high satisfaction with school reduces school absenteeism.

According to Haynes et al., 1997, students reported that the atmosphere in the schools they attend is characterized by high levels of mistrust and disrespect between students and teachers and a sense that students do not care about each other. Also according to the authors, negative comments and other criticisms from the teacher reduce students' self-concept and probably increase students' feelings of inadequacy and anxiety. Therefore, it is not a favorable climate for students' mental health, as they do not want to stay in places where they feel unwanted and unwelcome (Haynes et al., 1997). A climate such as the one described by these students has been shown to contribute to dropout rates and disciplinary problems (Anderson, 1982).

In addition, the school environment in which students live can predict and promote their satisfaction with life and satisfaction with the school (Suldo et al., 2013). In general, in Brazil, young people show good levels of satisfaction with life (Segabinazi et al., 2010) corroborating the international literature (Huebner, 2000; Huebner et al., 2009). However, the school has been the domain, among the specific domains of life satisfaction for adolescents, with the lowest satisfaction averages both in national and international studies (Huebner, 2000; Segabinazi et al., 2010). According to Coelho et al., 2019, since young people spend most of their time at school, this context should be considered a key scenario for interventions aimed at promoting the well-being of students.

One of the dimensions of the school climate is related to the sense of belonging to each other at school, that is, the school connection. School connection is a powerful predictor of adolescent health, academic outcomes (Mcneely et al., 2002; Shochet et al., 2006; Whitlock, 2006), violence prevention (Karcher, 2002, 2004), and as a protective factor in risky sexual behavior, violence, and drug use (Catalano et al., 2004; Kirby, 2001). Smith et al. (2021) pointed out that the sense of belonging is a positive predictor of students' liking and valuing of mathematics using Trends in International Math-Science (TIMSS). The authors found that especially for the Portuguese students the relationship was stronger for males than females.

Therefore, the school climate affects students' motivation to learn (Eccles et al., 1993; Goodenow and Grady, 1993). Thus, a positive school climate promotes cooperative learning, group cohesion, respect, and mutual trust, directly improving the learning environment (Finnan et al., 2003; Ghaith, 2003; Kerr, 2004). On the other hand, classroom climates characterized by conflict are associated with poorer peer relationships, more aggression, and worse outcomes, including academic focus and performance (Jones and Bouffard, 2012). Blank and Shavit (2016) pointed out that transgressive behaviors in the classroom are negatively correlated with students' academic performance. Meanwhile, positive relationships with the teacher promote self-regulation that supports children's behavior in the classroom and, in turn, contributes to a positive school climate (Osher et al., 2020). This climate supports the social and emotional development of students, helping them to be effective learners (Hamre and Pianta, 2010).

Students who maintain a closer relationship with teachers feel more confident and positive in their approaches to learning and feel more comfortable asking for help (IOM and NRC, 2015). Positive student-teacher relationships can help students reach, engage, regulate their emotions, build social competence, and take on academic challenges (Osher et al., 2018). High-quality teacher and student relationships can also reduce the threat of stereotyping (Steele, 2011), protect students who are at higher levels of risk for poor outcomes (Roorda et al., 2011), and dampen the effects of victimization and other adversities (Norwalk et al., 2016).

The well-being of teachers and working conditions are important (Pianta, 2016). Many educators are challenged by excessive cognitive demands, a lack of cultural and linguistic competence, or an inability to meet the children's developmental needs or respond to the impacts of trauma on children and adults (Baird and Kracen, 2006). Teacher stress is important and is affected by the teacher's ecology, which includes the level of support from the school principal, job stress, and the teacher's ability to manage students' feelings and behaviors (Jennings and Greenberg, 2009; Johnson et al., 2012). Teacher stress affects student interactions, student stress levels, teacher behavior, and student academic performance (Flook et al., 2013). Teachers in schools with disciplinary and supportive structures report more job satisfaction and less burnout syndrome (Aldridge and Fraser, 2016; Berg and Cornell, 2016; Mostafa and Pál, 2018).

In addition, students may feel that the school climate is negative and may duplicate their transgressive actions if they perceive teachers to be unfair or biased in their interpretations of student behavior (Pena-Shaff et al., 2019). However, the school climate can vary due to characteristics that are beyond the control of teachers. Studies show that socioeconomically advantaged schools usually have a positive school climate when compared to socioeconomically disadvantaged schools (Ma and Willms, 2004; OECD, 2016). Furthermore, a positive climate can mitigate the strong and pervasive link between economic status and academic achievement (Berkowitz et al., 2017). Schools with safe, caring, and respectful learning environments protect students from engaging in risky behavior such as skipping classes, smoking, drinking, and using drugs (Catalano et al., 2004; Gase et al., 2017; Larusso and Romer Selman, 2008). Therefore, students are more likely to reach their social, academic, and emotional potential in a safe, supportive, and collaborative environment (OECD, 2019).

Finally, a positive school climate promotes cooperative learning, group cohesion, respect, and mutual trust (Thapa et al. 2013). These specific aspects have been shown to directly improve the learning environment (Finnan et al., 2003; Ghaith, 2003; Kerr, 2004). Thapa et al. (2013) analyze that a positive school environment is associated not only with a happy childhood, but also contributes to healthy development in youth, student learning, academic performance, increased schooling, as well as greater teacher permanence in the same workplace.

Thus, the consequences of a positive school climate result in a reduction of barriers to teaching and a contribution for teachers to achieve success in their role. According to Kellam et al., 2011, effective teaching practices, support for student behavior, and a positive school climate can counteract the effects of chronic stress on students and the outcomes for students who are at high levels of risk.

In light of the foregoing Berkowitz et. al (2017) points out that it is important to understand the role of the school climate and its relationship with academic performance. The literature seems to agree that a positive school climate promotes student learning, academic performance, academic success, and healthy development, as well as effective risk prevention, positive youth development efforts, and increased teacher retention (Cohen et al., 2009).

3. Methodology and database

3.1. Database

The Program for International Student Assessment (PISA) measures the educational level of 15-year-olds through tests in reading,

Table 1
Descriptive Statistics.

Variables	Description	Positive school climate		Negative school climate	
		Mean	SD	Mean	SD
Dependent variables					
grade_math	Grade on the Math test	411.38 * **	84	385.54 * **	84.86
grade_reading	Grade on the Reading test	446.92 * **	95.06	419.37 * **	94.84
grade_sciences	Grade on the Sciences test	431.55 * **	87.21	408.48 * **	85.29
Variables					
private	Student goes to private school= 1 i/o = 0	0.16 * **	0.37	0.12 * **	0.32
male	Student is male = 1, i/o = 0	0.48	0.49	0.46	0.49
None	Father's education level = 1, i/o= 0	0.12	0.32	0.12	0.33
ISCED 1	Father's education level = 1, i/o= 0	0.13	0.33	0.13	0.33
ISCED 2	Father's education level = 1, i/o= 0	0.13	0.34	0.14	0.34
ISCED 3B, C	Father's education level = 1, i/o= 0	0.03	0.18	0.03	0.17
ISCED 3 A, ISCED 4	Father's education level = 1, i/o= 0	0.23 * **	0.42	0.2 * **	0.4
ISCED 5B	Father's education level = 1, i/o= 0	0.11 * **	0.32	0.13 * **	0.34
ISCED 5 A, 6	Father's education level = 1, i/o= 0	0.19	0.39	0.19	0.39
None	Mother's education level = 1, i/o= 0	0.09	0.28	0.1	0.29
ISCED 1	Mother's education level = 1, i/o= 0	0.11	0.31	0.11	0.31
ISCED 2	Mother's education level = 1, i/o= 0	0.15	0.36	0.15	0.36
ISCED 3B, C	Mother's education level = 1, i/o= 0	0.03	0.18	0.03	0.17
ISCED 3 A, ISCED 4	Mother's education level = 1, i/o= 0	0.26 * *	0.44	0.24 * *	0.43
ISCED 5B	Mother's education level = 1, i/o= 0	0.09	0.29	0.1	0.3
ISCED 5 A, 6	Mother's education level = 1, i/o= 0	0.24	0.43	0.25	0.43
grade_retention	Student repeated a grade = 1, i/o= 0	0.2 * **	0.4	0.27 * **	0.45
age	Student's age in years	15.9	0.38	15.9	0.28
size_class	Total number of students in the Portuguese class	36–40 students* **		36–40 students* **	
number_teachers	Total number of teachers in the school	39.49 * *	38.87	37.65 * *	35.19
number_girls	Total number of girls in the school	449.55	334.08	451.19	324.64
number_boys	Total number of boys in the school	410.22	281.24	422.28	291.92
teacher_support	Teacher support	0.6 * **	0.84	0.32 * **	0.93
escs	Student's economic, social and cultural indicator	-1.02 * *	1.23	-1.08 * *	1.17
years_teacher	Teacher's years of experience	15.88	8.89	15.7	8.62
like_me	Child has the perception of other students liking them = 1, i/o= 0	0.69 * **	0.46	0.61 * **	0.49
feel_dislocated	Child feels dislocated at school = 1, i/o= 0	0.13 * **	0.34	0.2 * **	0.4
feel_belongging	Child feels part of the school = 1, i/o= 0	0.66 * **	0.47	0.58 * **	0.49
friendship_easy	Child makes friendship easy = 1, i/o= 0	0.6 * **	0.49	0.56 * **	0.49
feel_weird	Child feels weird at school = 1, i/o= 0	0.16 * **	0.37	0.24 * **	0.42
feel_alone	Child feels alone at school = 1, i/o= 0	0.15 * **	0.36	0.2 * **	0.4
climate_test	School climate	0.78 * **	0.57	-0.86 * **	0.676
N (number of observations)		2631		5712	

The median of this variable was used since the school answers the average size of the Portuguese class between i) 15 students or less; ii) from 16 to 20 students; iii) from 21 to 25 students; iv) from 26 to 30 students; v) from 31 to 35 students; vi) from 36 to 40 students; vii) from 41 to 45 students; viii) from 46 to 50 students; ix) more than 50 students.
Source: Prepared by the authors based on PISA 2018.
Note: * ** $p < 0.01$, * * $p < 0.05$.

Mathematics, and Science. This age cut occurs because it presupposes the end of compulsory basic education in most countries. PISA is carried out every three years by the Organization for Economic Co-operation and Development (OECD) – which is made up of 30 countries whose principles are democracy and a market economy. Countries that are not part of the OECD can also participate in the exam, as is the case in Brazil. The National Institute of Educational Studies and Research Anísio Teixeira (INEP) is responsible for administering the program's tests in the country.

PISA aims to produce indicators that contribute to the discussion of the quality of basic education and that can help in national policies to improve education. In addition, through the tests, the program seeks to identify not only how the students reproduce their knowledge, but also the ability to use this knowledge inside and outside the school context. A specific area of knowledge is emphasized each year in PISA, that is, most questions are directed towards that area. In 2018, the area emphasized was reading. The program is among the most recognized global assessments of education.

PISA is applied on a sampling basis in which data from the school records of each participating country is used in the selection process. In the case of Brazil, the data used are from the School Census. The organization of PISA determines that each country has at least 150 schools participating in the test. In 2018, PISA was applied in 597 public and private schools with 10,961 students and approximately 7000 teachers. Thus, the sample size can guarantee us greater confidence in the representativeness of the results achieved by Brazil.

The school climate was defined based on an index created by PISA[4] in which students answer the frequency ('all classes', 'most classes', 'some classes', 'never or almost never') with which the following situations occurred in classes in the language of instruction: 'Students don't listen to what the teacher says.'; 'There is noise and disorder.'; 'The teacher has to wait a long time for students to quiet down.'; 'Students cannot work well.'; 'Students don't start working for a long time after the lesson begins.' These statements were combined to create the index of disciplinary climate whose average is 0 and the standard deviation is 1 across OECD countries. In other terms, positive values for this variable mean that students enjoyed a better disciplinary climate in reading classes than the average student in OECD countries. Thus, we divided the sample into two groups: students who reported a negative climate (treatment group) and those who reported a positive climate (control group). In these groups, we have 68.46% of students who reported a

[4] Sensitivity tests were performed with the variables created by the PISA of bullying and sense of belonging. Since they had no impact on the results, it was decided to remove this information from the work, since both have many missings and would leave the sample very small.

negative climate and 31.54% who reported a positive climate. In addition, the indices[5] also created by PISA included: i) support from the reading teacher (subject emphasized in 2018); ii) students' economic, social, and cultural status index (escs).

Table 1 present the descriptive statistics and the columns were divided between the control group – students who reported a positive school climate – and the treatment group – students who reported a negative school climate. To eliminate outliers from the sample, schools that declared that they did not have teachers were removed from the sample. It should be noted that only the observations that did not have missings in any variable were kept. The final number of observations in the sample was 8343 students, the sample loss was 23.88%, with students reporting a negative school climate representing 68.46% of the total. Regarding the number of schools, the final sample was 441 schools and the sample loss was 26.13%.

In Table 1, the two groups can be classified according to their proficiency levels on the PISA scale.[6] In science, for example, students in the treatment group (negative school climate) reach level 1 on the scale, while students in the control group (positive school climate) reach level 2. In math, the treatment group reaches level 1a while the control group reaches level 2. In reading both groups reach level 2. It is possible to verify that the average grades of students who reported a good school climate are higher in all subjects compared to students who reported a negative climate.

Regarding the age, it is identified that the students are between fifteen and sixteen years old. Thus, there may be an age-grade distortion since PISA is applied to 15-year-old students who are enrolled from the 7th grade of elementary school through the third year of high school. This age cut is due to the presumption of completion of compulsory education. The variable 'grade_repetition' indicates that students in a negative school climate were held back more often when compared to the control group.

The variable that represents the economic, cultural, and social status of students, 'escs', is higher for students who reported a good school climate, indicating a better socioeconomic condition. The result corroborates Avvisati (2018), who found a positive correlation between this index and the disciplinary climate in Brazil. It should be noted that this indicator is elaborated by PISA through the item response theory and the negative sign of the variable shows that the Brazilian average is below the average of the OECD countries.

Students whose school has a better school climate feel greater support from the Reading teacher compared to those with a negative school climate. However, both groups of students perceive more frequent teacher support than the OECD average since the values are positive. In addition, the teachers' years of experience were not significant but pointed out that schools with positive climates have teachers with slightly higher levels of experience. Schools with a positive school climate have a greater number of teachers than those with a negative climate.

Regarding the variables concerning the perception of the student within the school, the students who have reported a negative climate are the ones who feel the most displaced, alone, and strange. However, those who have reported a positive climate are the ones who make friends more easily, feel that they belong to the group, and feel that their colleagues like them. According to OCDE (2017) reducing disciplinary problems in classrooms not only improves student performance but also provides an orderly learning environment that is conducive to supportive social relationships.

The variable 'climate_test' is the index also developed by PISA in which students who indicated a positive climate enjoyed a better disciplinary climate in reading classes than the average student in OECD countries. Brazilian students who reported a negative school climate were below the OECD average.

3.2. Methodology

3.2.1. Propensity score matching

According to the potential outcomes model, each student has two outcomes Y_{i1} (negative school climate) and Y_{i0} (positive school climate), however, only one of these outcomes can be observed per student. Thus, the result not observed for students who are enrolled in a school with a negative school climate, if they were in a school with a positive school climate, is considered the counterfactual. This is the selection hypothesis in observables, or conditions of ignorance. However, as both results cannot be observed simultaneously for the same student i, it is necessary to employ a control group. For this, it is estimated a propensity score matching (PSM) method.

The PSM is a quasi-experimental methodology that mimetics randomization because the student allocation between schools is not random. The methodology was developed by Rosembaum and Rubin (1983) and sought to analyze the probability of a group receiving treatment, considering the various observable characteristics, X, in common between the two groups. Thus, it is assumed that each member of the treatment group (student who experienced a bad school climate) has a peer in the control group (student who did not experience it). To avoid the dimensionality problem, the vector X of observable features is replaced by p(X), which is defined as the propensity score:

$$P(X) = Pr(T = 1|X) \tag{1}$$

If the hypothesis of selection in observables, or condition of ignorance, is valid, the independence between the potential result in the absence of treatment and the decision to participate or not will also be valid. Therefore,

$$Y_i(0) \perp T_i | X \quad \Rightarrow Y_i(0) \perp T_i \, | p(X_i) \tag{2}$$

Where Y_i is the variable to be explained (students' school performance in science, mathematics and reading), T_i is the treatment (reporting bad school climate) and X_i is the vector of explanatory variables. Therefore, it is possible to estimate the mean treatment effect on the treated (ATT) by matching between individuals who experienced a negative climate at school and those who did not, based only on the propensity score. However, to estimate the propensity score it is necessary to apply a logit or probit model since it is not known. In the case of this study, we will use the logit model:

$$\Pr(T = 1|X = x) = \frac{\exp(x\beta)}{1 + \exp(x\beta)} \tag{3}$$

Where β is the vector of parameters that will be estimated in the first stage. $\widehat{\beta}$ is the estimator of β, so the propensity score is estimated as:

$$\widehat{p}(x) = \frac{\exp(x\widehat{\beta})}{1 + \exp(x\widehat{\beta})} \tag{4}$$

One of the most used estimators to define the proximity of the propensity score of individuals who experienced a negative school climate in relation to the propensity score of individuals who did not report a negative school climate is the nearest neighbor matching. This estimator uses the results of the N individuals in the untreated group (who reported a good school climate) who have propensity scores closer to the propensity score of individual i who reported a bad school climate to estimate what the outcome of this individual i would be if s/he didn't experience a negative climate. In addition, in the present work, the nearest neighbor method with replacement was used since the

[5] The development of each of these indexes can be found in https://www.oecd-ilibrary.org/sites/0a428b07-en/index.html?itemId= /content/component/0a428b07-en

[6] The PISA scale can be found in https://www.oecd.org/pisa/data/pisa2018technicalreport/PISA2018%20TecReport-Ch-15-Proficiency-Scales.pdf

counterfactual can be matched with different treated observations. The advantage of using this method is that the quality of the matching increases, as well as the bias, is reduced (Caliendo and Kopeinig, 2008). To give greater robustness to the results were estimated the PSM with 3 and 5 nearest neighbors, and also the Kernel and Radius methods.

H_N being the set of M observations with the lowest value of $|\widehat{p}(X_j) - \widehat{p}(X_i)|$, it is possible to construct the sample analogue for the individual's potential outcome if s/he were not treated:

$$\widehat{Y}_i(0) = \frac{1}{M}\sum j\epsilon H_M(i)Y_j \tag{5}$$

The average treatment effect on the treaties (ATET), when assuming the hypothesis of conditional independence (HCI), is $E[Y_{1i} - Y_{0i}|X_i]$. Assuming the HCI, the ATET resulting from the direct matching of the propensity values between treated and non-treated, applying the law of iterated expectations on X_i, is:

$$ATET = E[Y_{1i} - Y_{0i}|T_i = 1] = E\{E[Y_{1i}|P(X_i), T_i = 1] - E[Y_{0i}|P(X_i), T_i = 0]\,|T_i = 1\} \tag{6}$$

The typical estimator of the propensity score matching is described below:

$$ATET_{PSM} = \frac{1}{N_T}\left[\sum_{i\in D} Y_{1,i} - \sum_{j\in C}\omega(i,j)Y_{0,j}\right] \tag{7}$$

Where N_T is the number of treated individuals belonging to the common support region and $\omega(i,j)$ is the weighting scheme used to aggregate the potential outcome of individuals in the control group and depends on the propensity score of the participant *i*, $P(X_i)$, and of the propensity score matching of non-participant *j*, $P(X_j)$.

To give greater robustness to the results the Inverse Probability-Weighted Regression-Adjustment (IPWRA) - known as one of Wooldridge's (2007) doubly robust estimators- was also estimated. The estimation occurs in three stages and uses the inverse of the probability of experiencing a negative climate to estimate the adjusted regression coefficient. First, the model parameters are estimated, and the propensity score is calculated; subsequently, the inverse probability weighting is used and adjusted to the regression models. Finally, the grades are averaged for students who have been experiencing a negative climate to provide the ATT. Through this test, it is possible to remove the influence associated with the fact that the student is observed in only one of the situations of having a good or a bad climate (treated or untreated), mitigating the fact that there is insufficient information. Imbens and Wooldridge (2009) showed that the combination of weighting with regression aims to circumvent the problem of poor specification, whether it is derived from the regression model or the propensity score equation.

3.2.2. Robustness analysis

Factors that are not observed in the estimation can bias the results of the treatment effect on the treated. Therefore, the bounds analysis measures the potential impact of selection bias that arises from unobserved variables. The method known as the Rosenbaum bounds (ROSENBAUM, 2002) was used in this work. The purpose of the test is to estimate the influence of a possible omitted variable on the existing selection bias on the probability of participation in the treatment, which may eventually affect the conclusions regarding the causal effects.

This sensitivity analysis can be used to test the robustness of the results to the presence of an omitted covariate. In this work, the test aims to assess the impact of a possible omitted variable on the students' grades. Rosenbaum bounds can be expressed by equality:

$$\frac{1}{e^{\gamma}} \leq \frac{\theta_i(1-\theta_j)}{\theta_j(1-\theta_i)} \leq e^{\gamma} \tag{8}$$

Where *i* and *j* are two individuals with observable characteristics within a logistic distribution and γ expresses the measure of the degree of disruption of a sample free from selection bias. Thus, when $\gamma = 0$, the degree of the association will be equal to one, implying no selection bias.

3.2.3. Dose-response function

The dose of treatment may not be homogeneous among all the treated. In the case of this article, students report that school interruptions occur in all classes or most classes or some classes and, finally, never or almost never. Thus, there is an effect on grades that can vary with exposure to the program (bad school climate). Therefore, the Dose-Response Function (DRF)[7] was estimated, which measures the causal impact of an intervention according to the exposure of individuals to the program, measured here through the student's perception of the school climate.

The disciplinary climate variable was the same used in the PSM methodology, the index elaborated by PISA. The perception of the school climate is heterogeneous and gives us two groups of student matches: those who feel that the climate is good (ie, the treatment is zero 0) and those who feel that the climate is bad. However, there may be different levels of treatment, so we estimate a DRF that measures the causal effect of different treatment intensities.

Being $CE_{ij}(y_1)$ the results of the school climate for a student match *ij* when treated and $NCE_{ij}(y_0)$ when the same match is not treated. The treatment indicator, w_{ij}, assumes value 1 if treated and 0 for untreated, while the variable t_{ij} assumes values within the range [0,100]. Thus, the index created by PISA was transformed into a binary one being equal to one when less than zero (w_{ij}). In addition, this index was also normalized to the smallest value to assume zero and, finally, it was transformed to the range [0.100] (t_{ij}). The set of variables x_{ij} are the observable characteristics of students (listed in Table 1).

N being the total number of matches of students with N_T being the numbers of matches of treated and N_0 the number of control matches. So, two functions are defined $g_T(x_{ij})$ and $g_0(x_{ij})$ as response matches of *ij* to the vector of variables when the match is treated and untreated, respectively.

Given the above, a specific population generation process is assumed for the two unique potential outcomes:

$$\left\{\begin{array}{c} w = 1 : CE = \quad \mu_T + g_T(x) + h(t_{ij}) + \epsilon_T \\ w = 0 : NCE = \quad \mu_0 + g_0(x) + \epsilon_0 \end{array}\right\} \tag{10}$$

Where μ_T and μ_0 are scalar, ϵ_T and ϵ_0 are random variables with zero mean and constant variance, $h(t_{ij})$ is a general differentiable function of t_{ij} which differs from zero only if the individual is treated. The causal parameters of interest are the conditional ATEs of the population in *x* and t_{ij}:

$$ATE(x, t_{ij}) = E(CE - NCE)x, \quad t_{ij})$$

$$ATET(x, t_{ij} > 0) = E(CE - NCE)x, \quad t_{ij} > 0) \tag{11}$$

$$ATENT(x, t_{ij} = 0) = E(CE - NCE)x, \quad t_{ij} = 0)$$

Where *ATE* indicates the overall average effect of the treatment, *ATET* the average effect of the treatment on the treated and the *ATENT* is the average treatment effect on untreated units. If $g_0(x) = x\delta_0$ and $g_T(x) = x\delta_T$ are linear parameters, the conditional ATE on *x* and t_{ij} becomes:

[7] In this study, the model used is the one proposed by Cerulli and Poti (2014) whose programming in Stata is described in Cerulli (2015)

Table 2
Matching and OLS Results.

School Climate	Math grade	Sciences grade	Reading grade
OLS˙	-7.45 * **	-5.06 * **	-8.19 * **
PSM n(1) with repetition	-15.33 * **	-13.2 * **	-14.88 * **
PSM n(3)	-12.34 * **	-10.05 * **	-12.7 * **
PSM n(5)	-11.9 * **	-9.44 * **	-11.95 * **
Kernel	-12.22 * **	-10.42 * **	-13.08 * **
Radius	-12.3 * **	-10.5 * **	-13.2 * **
IPWRA	-12.64 * **	-10.59 * **	-13.37 * **

Source: Prepared by the authors
Note: * ** $p < 0.01$, * * $p < 0.05$.
˙School fixed effects and peer effects were included

$$ATE(x, t_{ij}, \quad w) = w \times \{\mu + x\delta + \quad h(t)\} + (1 - w) \times (\mu + x\delta) \tag{12}$$

Where $\mu = (\quad \mu_T - \quad \mu_0)$ and $\delta = (\quad \delta_T - \quad \delta_0)$ and the ATE is related to the model of Eq. (12), we have:

$$ATE = p(w = 1) \times (\mu + \overline{x}_{t>0}\delta + \overline{h}_{t>0}) + p(w = 0) \times (\mu + \overline{x}_{t>0}\delta)\overline{h}_{t>0} \tag{13}$$

Where $p()$ is the probability and $\overline{h}_{t>0}$ is the average response function given $t > 0$, we have:

$$ATE := p(w = 1) \times (\mu + \overline{x}_{t>0}\delta + \overline{h}_{t>0}) + p(w = 0) \times (\mu + \overline{x}_{t>0}\delta)$$

$$ATET := \mu + \overline{x}_{t>0}\delta + \overline{h}_{t>0} \tag{14}$$

$$ATENT := \mu + \overline{x}_{t>0}\delta$$

DRF is a function of treatment intensity t and is given by the mean $\quad ATE(x, t)$:

$$\left\{ \begin{array}{ll} ATE_t = & ATET + [h_t - h_{t>0}] if \quad t > 0 \\ & ATENT \quad if \quad t = 0 \end{array} \right\} \tag{15}$$

Before estimating the DRF, consistent estimation of the parameters of the potential outcomes of Eq. (10) is necessary. In previous definitions and assumptions, and in particular, the form of the potential outcomes of the model of Eq. (10) can be substituted into Rubin's potential outcome equation: $y_i = \quad y_{0i} + \ w(\ y_{1i} - \ y_{0i})$,the below model of random coefficients regression of basic parameters can be obtained (Wooldridge, 2003; Wooldridge, 1997):

$$y_{ij} = \mu_0 + w_{ij} \times ATE + x_{ij}\delta_0 + w_{ij} \times (x_{ij} - \overline{x})\delta + w_{ij} \times \{h(t_{ij}) - \overline{h}\} + \eta_{ij} \tag{16}$$

Where $\eta_{ij} = e_{0i} + w_i \times (e_{1i} - e_{0i})$. The response function $h(t)$ is then estimated by a polynomial regression that takes the following form:

$$h(t_{ij}) = at_{ij} + bt_{ij}^2 \tag{17}$$

From the Rubin regression for the potential results, the conditional independence of the means is assumed, and after algebraic manipulations, the estimator takes the following form, with T_i indicating the treatment

$$\widehat{ATE}_{CEL,l} = \ w\left[\widehat{ATET} + \widehat{a}\left(t_i - \frac{1}{n}\sum_{i=1}^{n} t_i\right) + \widehat{b}\left(t_i - \frac{1}{n}\sum_{i=1}^{n} t_i^2\right)\right] + (1 - w)\widehat{ATENT} \tag{18}$$

4. Results

Table 2 below shows the results of the school climate on the academic performance of students using different matching methodologies. Furthermore, in Figure A (APPENDIX) it is possible to verify the sample density before being matched and after the matching for each of the academic disciplines. After the matching procedure, it is possible to observe the superposition of the distribution of the treated and control groups, proving to be very similar. Furthermore, Table A1 (APPENDIX) also supports the robustness of the matching. It is possible to identify a reduction in the Pseudo-R^2 as well as in the mean and median bias in the matched sample. Furthermore, both the likelihood ratio (LR) and the Pseudo-R^2 test show that the statistical difference between the post-matching groups no longer exists. It is worth mentioning the p-value that becomes significant after matching, showing robustness in the results. Thus, these results indicate that the post-matching groups are similarly based on a vector of observable variables.

Also, Table B1 (APPENDIX) shows the difference in means between groups before and after matching. The mean difference between the two groups before the pairing was performed is significant, however, after using the PSM the difference in the means, for the most part, is not statistically different from zero.

Students who reported a negative school climate had their grades reduced by 15, 13, and 14, points, on average, according to the PSM methodology, in the subjects of mathematics, science, and reading, respectively. With this reduction in grades, the PISA scale for the treatment group is 1a, 1, and 1a in the subjects of reading, sciences, and mathematics, respectively. All subjects reduced remained at the same level on the scale except for reading which dropped one level for the treatment group. When estimating PSM with 3 and 5 nearest neighbors, Kernel, Radius, and IPWRA, the results were similar, students who experienced a negative climate had their grades reduced by 12, 10, and 13 points on average in the subjects of mathematics, science, and reading, respectively. Regarding the PISA scale, the only subject that changed the scale was reading, which decreased one level to 1a for all matching estimators.

According to the Rosenbaum tests, in Table 3, which tests the robustness of the results in the presence of some omitted covariate, one can observe that the results were satisfactory, as they reinforce the non-existence of bias in possible unobservable characteristics that affect the result. According to Dehejia (2005), when gamma approaches unity it can be an indication of unobservable bias that can influence the result. Therefore, the distance from the unit is a parameter that gives the result the confidence that the matching adjusts to the observable characteristics and remains stable for treatment.

Table 4 shows the DRF results in each of the subjects of the PISA.

The DRF results, which incorporate the frequency with which the negative climate occurs, show a slightly lower impact. In the case of the reading subject, students who reported a negative climate had their grades reduced by nine points on average compared to those who did not undergo interventions in the classes. In Math, the reduction was also by eight points on average while in sciences the reduction was by six points on average. The most affected grade was the reading one the same as the matching estimators except PSM.

Regarding the variables concerning the perception of the student within school, those who feel most displaced, strange, and who make friends more easily have negative impacts in all subjects according to Table 4. Meanwhile, the students who feel that their colleagues like them have a positive impact on their grades. The sense of school belonging is important as the student spends most of the time in school. School connection is a powerful predictor of adolescent health, and academic outcomes (McNeely et al., 2002; Shochet et al., 2006; Whitlock, 2006). According to Smith et al. (2021) sense of belonging is a positive predictor of students' liking and valuing of mathematics.

Also, to control the differences between schools, we estimated an

Table 3
Rosenbaum Tests.

Variable	Gamma	sig+	sig-	t-hat+	t-hat-	CI+	CI-
Math grade	1	0	0	391.61	391.61	389.72	393.49
	1.5	0	0	376.42	407.08	374.56	409.03
	2	0	0	365.98	418.09	364.09	420.12
Portuguese grade	1	0	0	413.14	413.13	411.21	415.07
	1.5	0	0	397.60	429.05	395.7	431.06
	2	0	0	386.97	440.39	385.05	442.47
Sciences grade	1	0	0	426.4	426.4	424.25	428.56
	1.5	0	0	408.9	444.11	406.74	446.31
	2	0	0	396.82	456.59	394.63	458.87

Source: Prepared by the authors

Table 4
Dose-response function of school climate on academic performance.

	Math grade	Sciences grade	Portuguese grade
School climate	-8.3 * **	-6.72 * *	-9.06 * **
private	64.54 * **	63.4 * **	65.94 * **
Male	17.7 * **	13.54 * **	-10.61 * **
Father - None	-4.5	1.61	-1.6
Father - ISCED 1	-6.98	0.78	-2.53
Father - ISCED 2	-7.06	-7.07	-1.06
Father- ISCED 3B, C	-11.6 *	-2.48	-4.67
Father - ISCED 3 A, ISCED 4	-01.87	4.14	2.01
Father - ISCED 5B	-16.67 * **	-10.5 * *	-7.09
Father -ISCED 5 A, 6	-10.1 * *	-6.73 * *	-11.11
Mother - None	17.3 * *	25.58 * **	21.33 * **
Mother -ISCED 1	26.47 * **	25.3 * **	18.578 * *
Mother -ISCED 2	5.7	13.13 *	8.38
Mother -ISCED 3B, C	-15.64 * *	-1.76	-9.55
Mother -ISCED 3 A, ISCED 4	8.3	11.3	7.98
Mother -ISCED 5B	1.4	0.29	-5.39
Mother -ISCED 5 A, 6	1.04	5.8	-7.3
grade_retention	-56.8 * **	-59.5 * **	-64.98 * **
Age	6.87 * *	12.1 * **	13.18 * **
size_class	-0.02	0.8	-0.11
number_teachers	0.4 * **	0.4 * **	0.5 * **
number_girls	-0.02 * **	-0.02 * **	-0.017 * **
number_boys	-0.002	-0.002	-0.007
years_teacher	-0.21 * *	-0.16	-0.18 *
teacher_support	-1.37	-1.56 *	-2.15 * *
Escs	21.48 * **	21.6 * **	23.2 * **
like_me	16.74 * **	15.35 * **	21.7 * **
feel_dislocated	-11.16 * **	-4.23	-8.69 * **
feel_belongging	2.43	4.09 *	6.05 * *
friendship_easy	-11.46 * **	-11.85 * **	-15.11 * **
feel_weird	-9.59 * **	-12.49 * **	-10.56 * **
feel_alone	-0.18	0.41	-0.32
Polynomial degree 1 (Tw_1)	0.29	0.28	0.31
Polynomial degree 2 (Tw_2)	0.002	0.0009	0.001
Constant	313.59 * **	239.46 * **	259.82 * **

*p < 0.1; * *0.05; * ** 0.01; Source: Prepared by the authors.

Table 5
Results with peer effects.

Variables	PSM	DRF
Math grade		
School climate	-11.8 * **	-4.9
Peer effects	-1.26 * **	19.12 * **
Reading grade		
School climate	-12.9 * **	-5.77
Peer effects	-1.26 * **	18.55 * **
Sciences grade		
School climate	-7.78 * *	-3.24
Peer effects	-1.26 * **	19.64 * **

Source: Prepared by the authors
Note: * ** $p < 0.01$, * * $p < 0.05$.

OLS model with school fixed effects to show the robustness of our results and also to mitigate the school differences that can occur. The results were in the same direction as previously estimated, however when incorporating these fixed effects, the impact on grades was lower. The student's grades who reported a bad climate were reduced by 7, 5, and 8 points on average in the subjects of mathematics, science, and reading, respectively.

The results corroborate what was found by Casassus (2008), which shows that students who enjoy a positive school climate have higher grades in math and language. A positive school climate affects the student's engagement with the school, being a mediator of the relationship between socio-economic background and academic performance (Wang and Holcombe, 2010). In addition, a positive school climate is associated with teacher satisfaction (Grayson and Alvarez, 2008). Consequently, teachers emphasized that teaching activities were devoted more tie since there were few interruptions during classes.

Also, Lazear (2001) points to a positive correlation between the number of students in a class and the number of interruptions. Therefore, the negative consequences would be the reduction of class time for productive learning as the number of students in the classroom increases. Teachers who teach in schools with negative school climate report higher levels of stress, lower empathy, irritability, and fragile engagement in the relationship with students. This situation leads to a drop in the quality of the class (Capel, 1991). Although some studies indicate a weak association between positive school climate, socioeconomic status, and school performance, a robust correlation is observed between negative school climate and low socioeconomic status and educational performance (Khoury-Kassabri et al., 2004).

The social disorganization theory (Shaw and Mckay, 1942) has been used to explain the relationship between violence in the community surrounding the school and low educational performance (Harding, 2009) because the characteristics of the neighborhood affect the intramural climate of the school by reducing the interest in staying in the school. According to Bandura (2017), students who live in these places easily internalize aggressive behaviors, and in this way, normalize violent episodes. Thus, Ruiz et al., (2018) use this theory to explain that the negative school climate present in these places would be a mediating characteristic of the negative effects of socioeconomic status on student performance. However, the positive school climate, according to the theory of resilience, would act as a mechanism to protect the well-being of individuals at risk by mitigating the negative effects, according to Fergus and Zimmerman (2005). Thus, the increase in the positive school climate through engagement measures would affect teachers by reducing turnovers and students by reducing conflicts, making it a place for the development of their capacities (Cohen et al., 2009). The DRF results corroborate the theory above since the variable that captures the student's socioeconomic level (escs) is positively correlated with school performance, being statistically significant.

These findings have implications for research and policy. From a policy perspective, the Brazilian government just approved Senate Bill 4731/12, which sets the maximum number of students in preschool and the first two years of elementary school at 25 and 35 in the other years of elementary school and high school, which impacts the class interruption. Also, in Brazil, there is a law that establishes the Program of Fight against Systematic Intimidation (Bullying), and it is established the provision of bi-monthly reports regarding the occurrence of bullying in States and Municipalities to plan the next actions. However, this law has not been fulfilled and there is no notice regarding the reports. The negative school climate affects teachers and weakens the student-teacher relationship since it reduces the production time for the transmission of knowledge during classes. In addition, the school climate also affects students, as it affects learning by reducing aspects related to self-esteem and bullying. So, our findings show how important the class size and Bullying are to the school climate and consequently to the student's performance.

From a research perspective, these findings underscore the need to better understand the levels of exposure to a negative school climate. Through the results of the DRF, it was possible to understand that those students who suffer from a negative school climate often have a greater negative impact on their grades than those who report experiencing negative climates sometimes. It is important to understand the student's learning environment as it impacts their academic performance, and also how exposed to this negative environment they are.

In addition, the results also validate what was found by the OECD study (2019) in which students with fewer disciplinary problems in reading classes had a better academic performance. The literature points to a correlation between school climate and performance (Casassus, 2008; Jones and Bouffard, 2012; Blank and Shavit, 2016; Warner and Heindel, 2017; Reynolds et al., 2017).

Figure B shows the estimated effect of school climate on student grades in each of the subjects evaluated. Through the figures, it is possible to observe that the effect of school climate on performance is negative, becoming smaller as the climate improves.

The sixty dose represents the cut of the average of the OECD countries, that is, below it, the students experienced a worse climate and above a better climate. Thus, in the zero dose are the students who reported the worst climate among Brazilian students and the ones with the greatest negative impact on the grade of all subjects assessed. When the dose approaches sixty, the effect becomes null since it is a straight line and all individuals are in the control group, that is, they reported a good school climate and so the climate does not affect the grades.

This result indicates that evaluating the dose of treatment is important since the impact on performance is different whether the student is in dose zero or dose ten. Thus, students who are exposed to a negative school climate in all reading classes have the worst academic performance in all subjects presented.

4.1. Peer effect

The peer effect is the influence of one student on another. In this section, we tested the peer effect of school climate (Table A1). Within a class, some students spend more time with the teacher implying less time for others (Lazear, 2001) also known as the "bad apple" (Sacerdote, 2011). Thus, in terms of school climate, a "bad apple" can impair the student's perception of the climate and it is necessary to evaluate the impacts of peer effects in this context.

Through Table 5, it is possible to analyze that the estimators are consistent with those obtained in Table 2, that is, a negative climate impacts the grade of the student who reports a negative school climate when considering the peer effects. However, the DRF coefficient of school climate for all classes loses magnitude, which reinforces the strong influence of peers since the peer effects are very significant. In the PSM methodology, the peer effects reduce 1.26 the grades of the three subjects.

According to Le and Nguyen (2019), children who suffer physical punishment at home, have more disruptive behaviors and lose interest in learning affecting the performance of colleagues in both math and language among Vietnamese fifth graders. Therefore, these results around peer effects can bring evidence of the importance of class formation since disruptive behavior on the part of the adolescent affects the performance of colleagues. In larger classes, teachers need to limit the time and attention they dedicate to individual students, and these classes have more chances of disruptive behavior (OECD, 2016). Meanwhile, in smaller schools, students reported a better disciplinary climate in their science lessons, and they are less likely to skip days of school and arrive late for school than students in larger schools (OECD, 2016).

The peer effect can also be seen through learning when a school peer plays truant other students at school are more likely to play truancy too (Duarte et al., 2011; Card and Giuliano, 2013). According to Wilson et al. (2008), truancy can impact the whole school through resentment among students who regularly attend classes, class interruptions, and teacher frustration. Therefore, peer effects are important to address the issue of school climate and student performance.

5. Conclusion

Classes are frequently interrupted, teachers are kept from doing their job because they need to maintain order in the classroom, and students do not listen to what the teacher says and do not work well. About 68% of Brazilian students reported that this is the climate of the schools they attend. According to this work, an unfavorable school climate negatively impacts students' grades. On average, students score twelve, ten, and fifteen points lower on math, reading, and science tests, respectively, compared to peers who reported a good disciplinary climate.

In addition, the results showed that the frequency with which these students are exposed to the school climate has a different impact on performance. In other words, those students who reported that the negative climate occurs in all reading classes are more harmed than other students whose frequency of exposure is decreasing. Also, to check the robustness of our results the Rosenbaum test showed the results were satisfactory which provides greater reliability to the results obtained.

The negative school climate affects students who are at the lower tail of the performance distribution more intensely compared to those who are at the higher points. In this framework, it is necessary to improve the school climate through the increase in teacher-student engagement, in addition to the reduction in conflicts within the student body. As the school climate is shown as a mediator between the student's socioeconomic level and learning, improvements in this characteristic would contribute to the school becoming a suitable place for the development of learning.

This work contributes to the literature on the subject, which is little discussed in Brazil. Furthermore, it contributes to addressing the association between school climate, perceived by students, and student performance in Brazil, more specifically, shows the intensity of exposure to negative climate is highly important to the design of public policies. For further research, analysis of full-time schools that would provide an increase in the student's interaction with the school, however, would not be a guarantee of improving the school climate. In this framework, it is necessary to encourage this so that the school does not reproduce the behavior of the surrounding community. Another analysis that can be made is about the post-pandemic period where students spent less time at school and classes were less interrupted while students developed more mental problems. Thus, an analysis of the post-pandemic school climate is important to assess the standard of schools in this period.

However, one of the limitations of this work is understanding the reverse causality mechanism that can exist between school climate and performance. That is, it is not yet clear whether the negative school climate causes underperformance or whether underperformance leads to a disorderly atmosphere in the classroom. Moreover, the school climate index created by PISA is measured through the student's perception which makes the definition subjective and therefore becomes a limitation of the work.

Finally, it is important to understand the environment that schools provide for students and how it affects their learning. The present work highlighted the importance of the school environment in the performance of Brazilian teenagers and how this mechanism should be further evaluated.

CRediT authorship contribution statement

Júlia Sbroglio Rizzotto: Conceptualization; Methodology; Formal analysis; Data curation; Writing – review & editing. **Marco Túlio Aniceto França:** Validation; Supervision.

Resumo

O artigo tem como objetivo avaliar o impacto do clima escolar no desempenho acadêmico dos alunos brasileiros por meio do Programa Internacional de Avaliaç ão de Estudantes (PISA) do ano de 2018. A metodologia empregada foi o *propensity score matching* (PSM), vizinho mais próximo, Kernel, Radius, Inverse Probability-Weighted Regression-Adjustment (IPWRA) e a funç ão dose resposta (FDR). Os resultados mostraram que um clima escolar negativo é prejudicial para o desempenho escolar dos estudantes e a intensidade do clima afeta de formas diferentes as notas. O efeito dos pares nas notas é significativo indicando que os colegas de sala de aula importam para a percepç ão do clima além de impactarem a nota dos demais. Além disso, o clima disciplinar nas aulas de português é um dos mais fortes preditores do desempenho acadêmico sendo de extrema importância entender a relaç ão de ambos.

Palavras-chave

Clima escolar, desempenho escolar, PISA.

Appendix

See Appendix Figs A1 and B1.
See Appendix Tables A1 and A2.

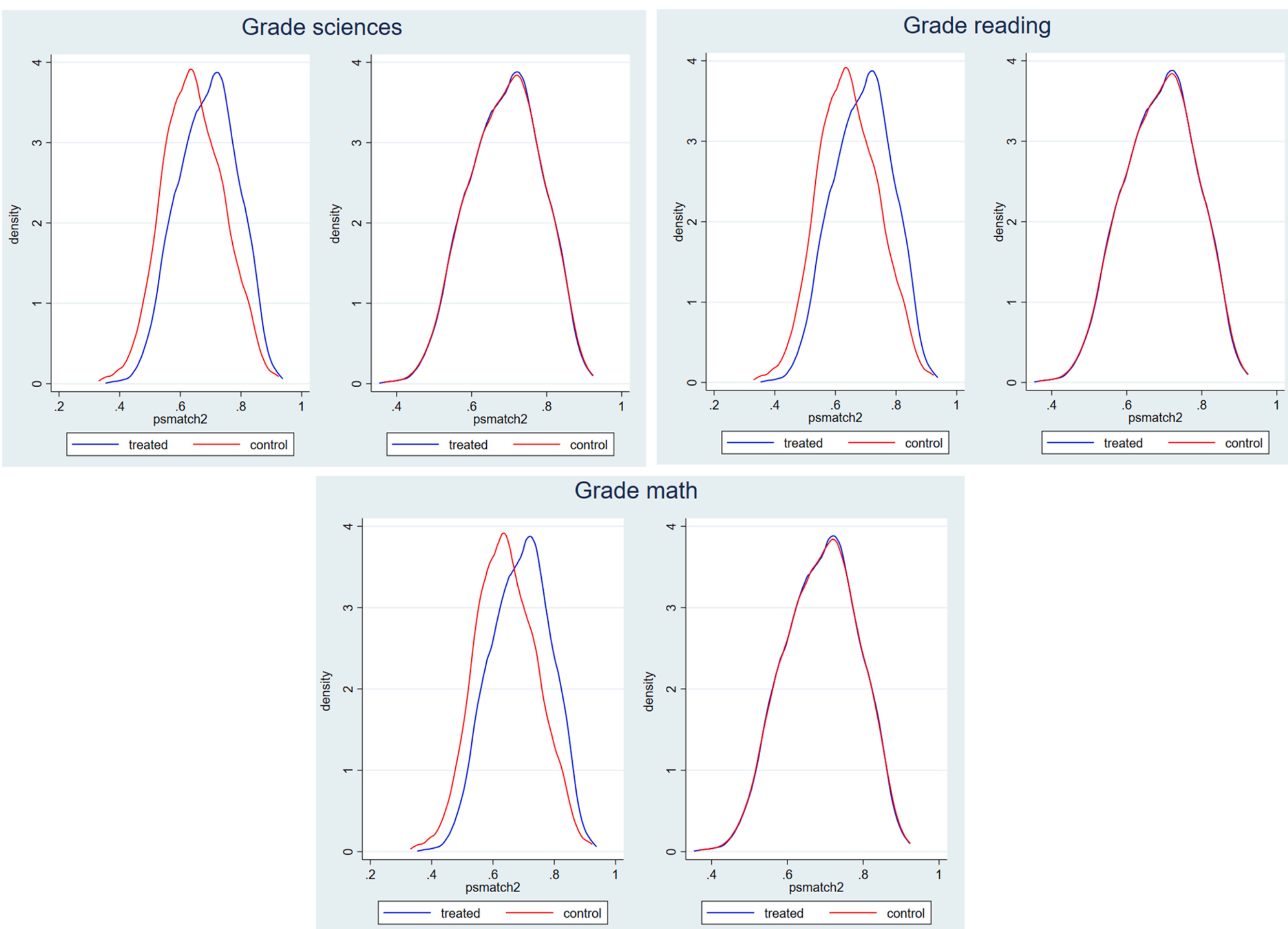

Fig. A1. Sample distribution before (left) and after matching (right).
Source: Prepared by the authors.

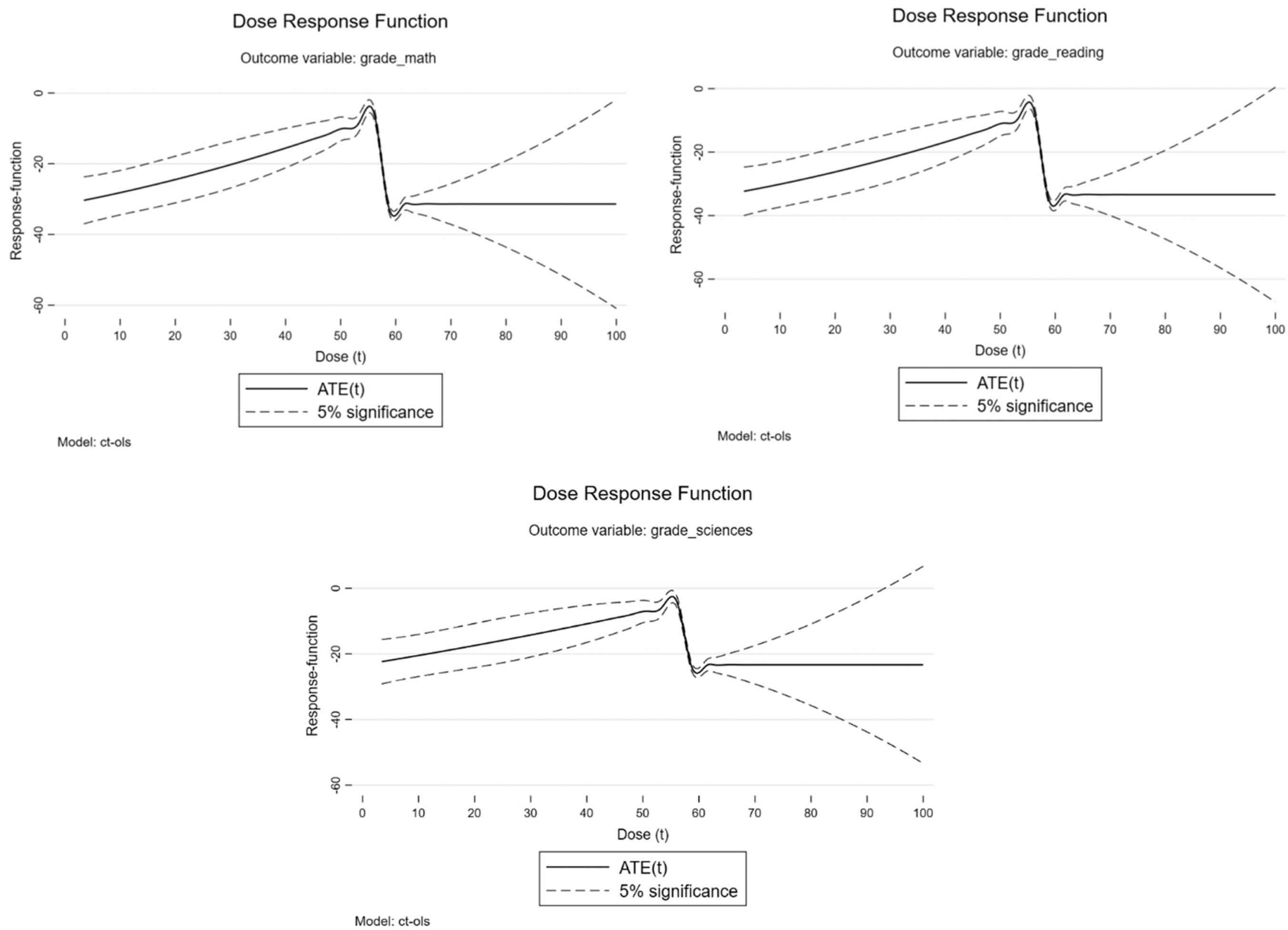

Fig. B1. Dose-Response Function of PISA's subjects grades.
Source: Prepared by the authors.

Table A1
Balancing pre and post matching.

	Pseudo-R2	LR chi^2	P-value	Mean Bias	Median Bias
Not matched	0.076	647.88	0	8.1	3.7
Matched	0.005	57	0.004	2.2	1.8

Source: Prepared by the authors

Table A2
Mean difference test between treatment and control groups with and without matching.

		Mean			
Variables	Match	Treatment	Control	Difference	*t-test*
private	No	0.12	0.16	-0.04 * **	-4.67
	Yes	0.12	0.11	0.01	2.57
male	No	0.47	0.48	-0.01	-0.73
	Yes	0.47	0.50	-0.02 * *	-2.16
Father None	No	0.13	0.13	0.00	0.04
	Yes	0.13	0.13	0.00	-0.69
Father ISCED 1	No	0.13	0.13	0.00	-0.14
	Yes	0.13	0.12	0.01 *	1.7
Father ISCED 2	No	0.13	0.13	0.00	0.64
	Yes	0.13	0.12	0.01	1.19
Father ISCED 3B, C	No	0.03	0.03	0.00	-0.55
	Yes	0.03	0.04	-0.01	-1.59
Father ISCED 3 A, ISCED 4	No	0.20	0.23	-0.02 * *	-2.54
	Yes	0.20	0.21	-0.01	-1.01
Father ISCED 5B	No	0.13	0.11	0.02 * **	2.62

(*continued on next page*)

Table A2 (*continued*)

Variables	Match	Mean		Difference	*t-test*
		Treatment	Control		
	Yes	0.13	0.14	-0.003	-0.52
Father ISCED 5 A, 6	No	0.20	0.19	0.003	0.3
	Yes	0.20	0.19	0.01	1.01
Mother None	No	0.10	0.09	0.01	1.32
	Yes	0.10	0.10	0.01	0.95
Mother ISCED 1	No	0.10	0.11	-0.01	-0.67
	Yes	0.10	0.11	-0.01	-0.27
Mother ISCED 2	No	0.15	0.15	0.00	0.35
	Yes	0.15	0.15	0.00	-0.76
Mother ISCED 3B, C	No	0.03	0.03	0.00	-0.01
	Yes	0.03	0.03	0.00	0.6
Mother ISCED 3 A, Mother ISCED 4	No	0.24	0.26	-0.02 *	-1.74
	Yes	0.24	0.26	-0.02 *	-1.84
Mother ISCED 5B	No	0.10	0.09	0.01	0.68
	Yes	0.10	0.09	0.01	1.46
Mother ISCED 5 A, 6	No	0.25	0.24	0.01	0.66
	Yes	0.25	0.24	0.01	1
grade_retention	No	0.28	0.21	0.07 * **	6.41
	Yes	0.28	0.28	0.00	0.33
age	No	15.91	15.92	-0.01	-1.41
	Yes	15.91	15.90	0.01	1.23
size_cass	No	36.57	38.08	0.52 * **	2.69
	Yes	36.59	36.92	-0.32	-1.29
number_teachers	No	36.57	38.08	-1.5 *	-1.71
	Yes	36.59	36.92	-0.32	-0.47
number_girls	No	439.27	440.82	-1.55	-0.19
	Yes	439.29	446.19	-6.89	-0.98
number_boys	No	413.01	402.34	10.67	1.44
	Yes	412.63	428.63	-16 * *	-2.42
teacher_support	No	0.34	0.61	-0.26	-11.51
	Yes	0.35	0.36	-0.01	-0.59
escs	No	-1.08	-1.04	-0.04	-1.45
	Yes	(−1.08)	(−1.08)	0.00	-0.21
years_teacher	No	15.68	15.90	-0.21	-0.94
	Yes	15.67	15.68	0.00	-0.00
like_me	No	0.62	0.69	-0.07 * **	-6.15
	Yes	0.62	0.62	0.00	-0.71
feel_dislocated	No	0.20	0.13	0.06 * **	6.21
	Yes	0.19	0.19	0.00	-0.00
feel_belongging	No	0.59	0.66	-0.07 * **	-5.69
	Yes	0.59	0.59	0.00	-0.32
friendship_easy	No	0.57	0.61	-0.03 * **	-3.06
	Yes	0.57	0.56	0.01	1.08
feel_weird	No	0.24	0.23	0.01 * **	7.34
	Yes	0.24	0.23	0.00	0.72
feel_alone	No	0.20	0.15	0.04 * **	4.44
	Yes	0.20	0.19	0.01	0.53

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